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#### MEMORANDUM FOR PR (Contractor/In-House Publication)

FROM: PROI (TI) (STINFO)

06 Jul 2000

SUBJECT: Authorization for Release of Technical Information, Control Number: AFRL-PR-ED-TP-2000-148 C.T. Liu; J.N. Yang (UC Irvine), "Determination of Equivalent Initial Flaw Size in Particulate Composite Material"

8<sup>th</sup> Specialty Conference on Probabilistic Mechanics and Structural Reliability (Notre Dame, IN, 24-26 Jul 00) (Submission Deadline: 18 Jul 00)

(Statement A)

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### Distribution A: Approved for Public Release

#### Determination of Equivalent Initial Flaw Size in a Particulate Composite Material

C.T. Liu

Air Force Research Laboratory 10 E. Saturn Blvd.

**Edwards AFB, CA 93524-7680** 

J.N. Yang

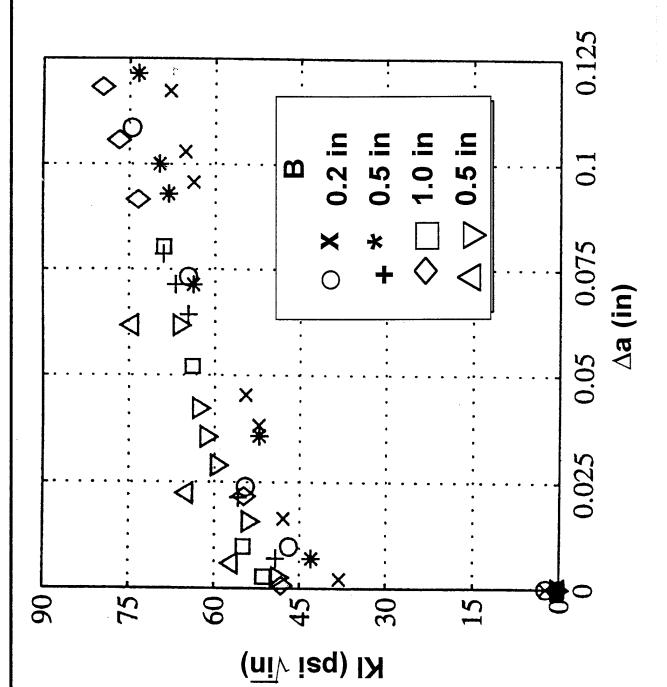
Civil Engineering Department University of California at Irvine Irvine, CA 92697



#### **Objectives**

- the Equivalent Initial and the Critical Flaw Sizes in Investigate the Effect of Specimen Thickness on a Particulate Composite Material.
- Determine the Statistical Distribution Function of the Equivalent Initial and the Critical Flaw Sizes.
- Normal Distribution
- Two parameter Lognormal Distribution
- Two Parameter Weibull Distribution
- Second Asymptotic Distribution of Maximum Value

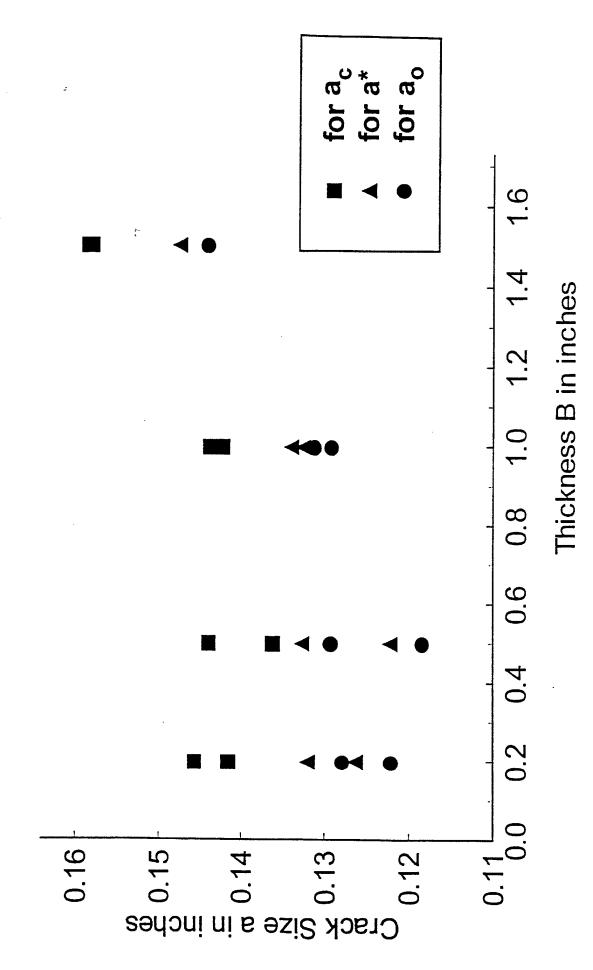
## **Crack Growth Resistance Curve**





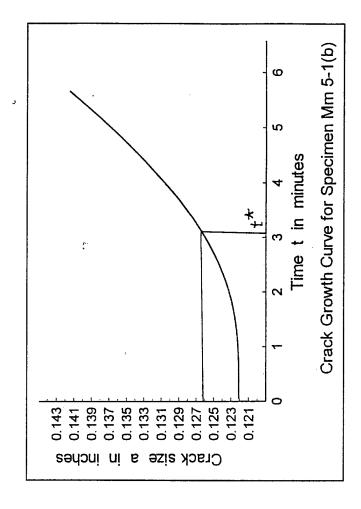
### **Equivalent Initial Flaw Size and Critical Flaw Size**

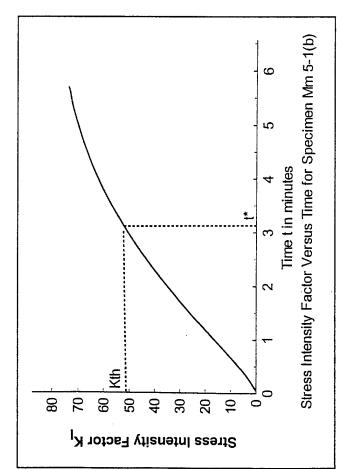




### Stress Intensity Factor Versus Time for Specimen Mm 5-1 (b)







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B





### Equivalent Initial Flaw Size and **Critical Flaw Size**

lowers in plots

inches 0.1362 0.1580 0.1415 0.1438 0.1456 0.1422 0.15840.1439 minutes 2.4900 2.8465 2.7359 2.0768 3.0755 2.9113 2.4644 2.4384 Inches 0.1320 0.1475 0.1327 0.1263 0.1222 0.1340 0.1326 0.1475 0.127880 0.129210 0.144086 0.122088 0.131190 0.129168 0.144033 0.118401 inches inches Width 1.000 1.000 1.050 1.000 **Thickness** inches 0.198 0.498 1.500 0.997 Mm 1-2.mad(a) Mm 1-2.mad(a) Mm 5-1b.mad Mm 15-2.mad Mm 2-2.mad Mm 5-1.mad Mm 5-2.mad Mm 1-1.mad Specimen **Test** 





### Distribution Parameters for Normal, Lognormal, Weibull and Asymptotic Distributions

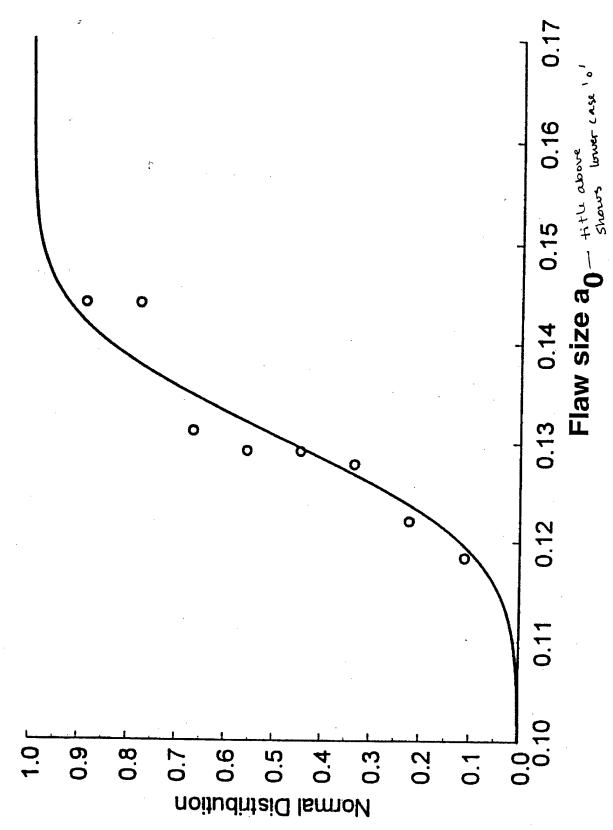
| $\alpha$ 17.5546 18.4513 23.0450 $\beta$ 0.1348 0.1383 0.1497 $k$ 13.2524 13.80.81 17.1205 $\delta$ 0.1258 0.2195 0.1419 | 3 ×3 *6 | 0.1308<br>0.0092<br>-2.037<br>0.07021 | 0.1344<br>0.0090<br>-2.0092<br>0.06692 | 0.1462<br>0.0079<br>-1.9242<br>0.053961 |
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| 0.1548       0.1583         13.2524       13.80.81         0.1258       0.2195   | ර ල     | 17.5546                               | 18.4513                                | 23.0450                                 |
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|  | n       | 0.1258                                | 0.2195                                 | 0.1419                                  |



#### Mean, Standard Deviation and **Coefficient of Variation**

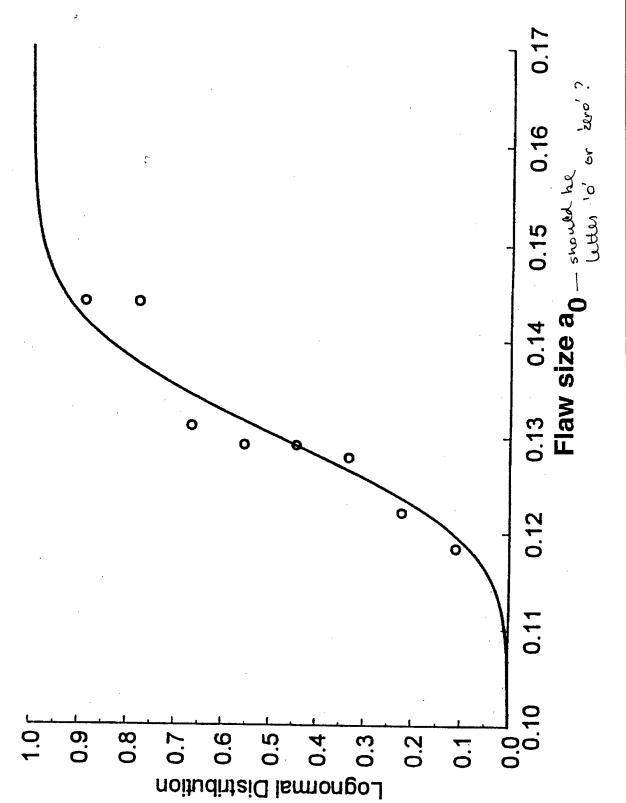
|                                | Let A. | <b>*</b> | ac a   |
|--------------------------------|--------|----------|--------|
| Mean (in.)                     | 0.1308 | 0.1344   | 0.1462 |
| Standard<br>Deviation<br>(in.) | 0.0092 | 0.0000   | 0.0079 |
| Coefficient<br>of Variation    | 0.0703 | 0.0670   | 0.0540 |

### Normal Distribution Plot for a<sub>o</sub>



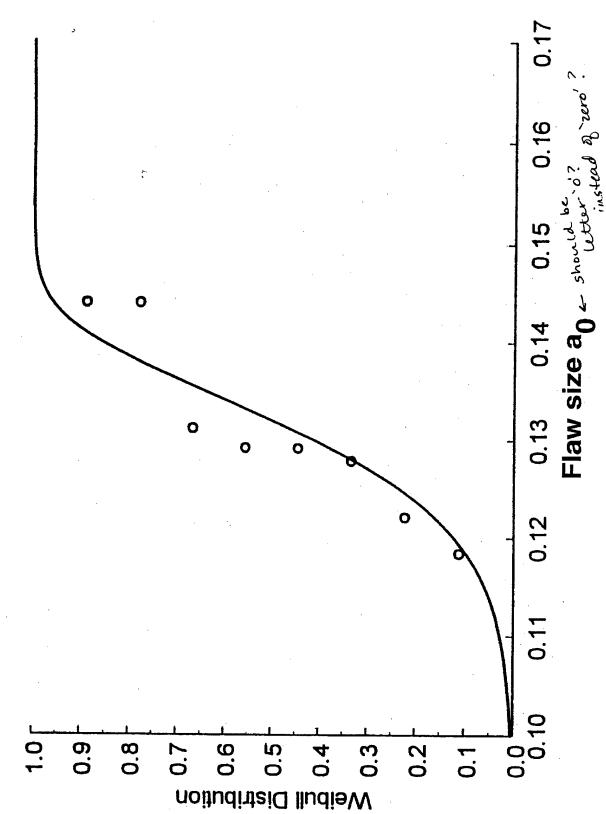


# Lognormal Distribution Plot for a<sub>o</sub>





### Weibull Distribution Plot for a<sub>o</sub>

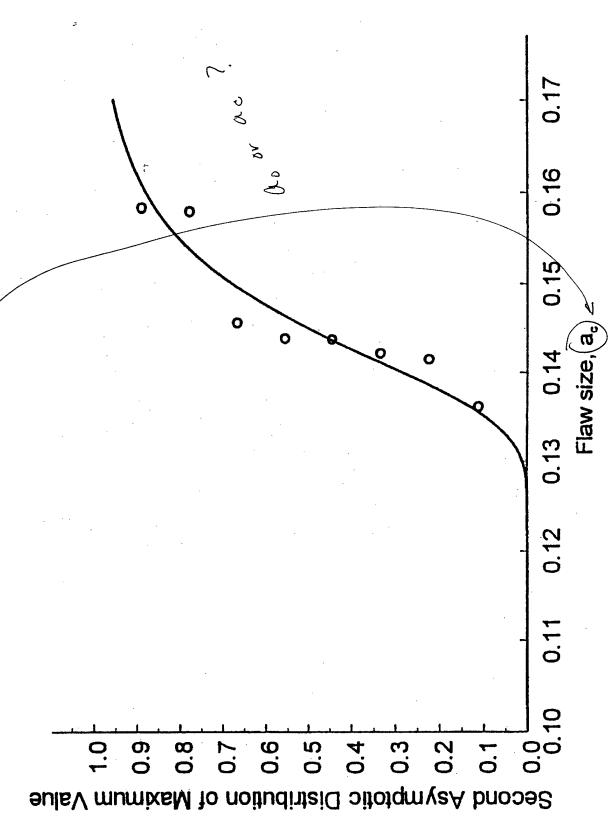




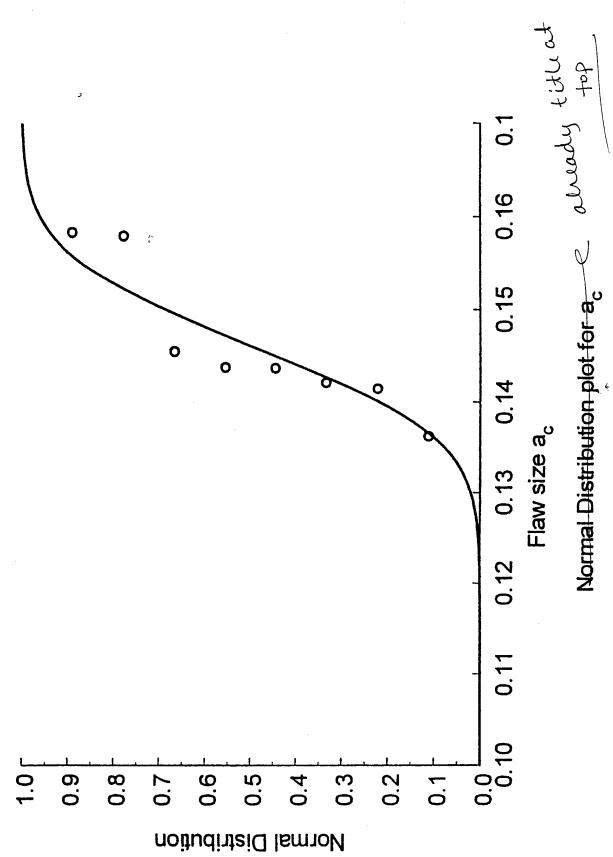


# Second Asymptotic Distribution Plot





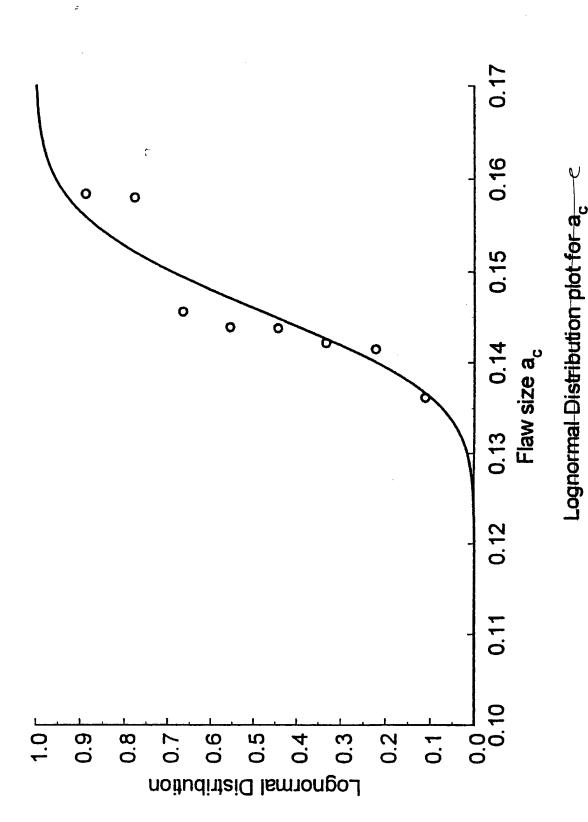
### Normal Distribution Plot for a<sub>c</sub>





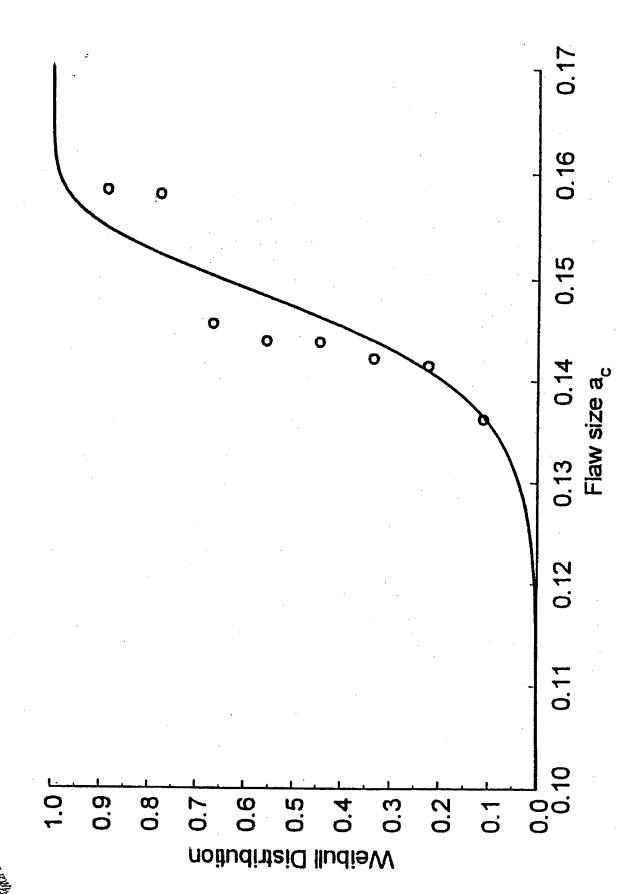
# Lognormal Distribution Plot for a<sub>c</sub>





### Weibull Distribution Plot for a<sub>c</sub>

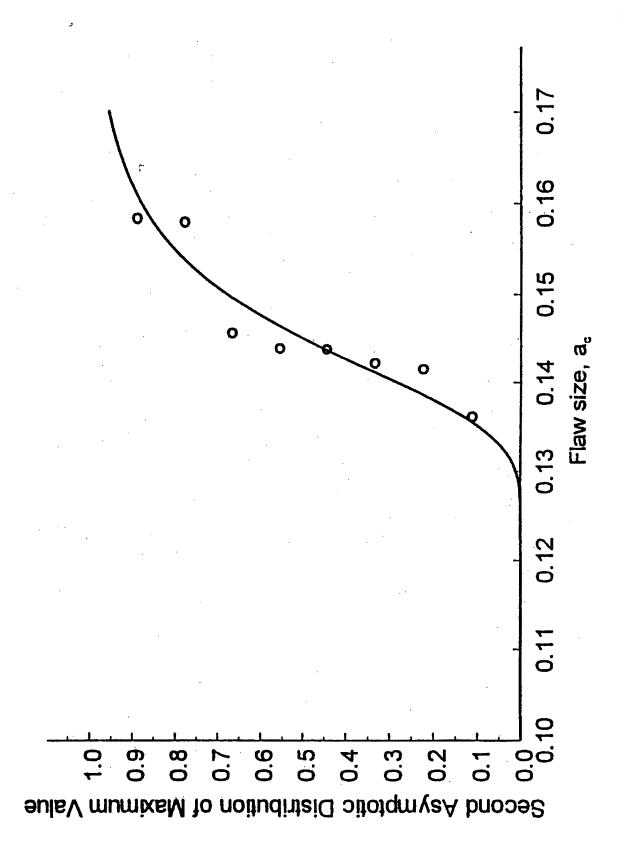
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# Second Asymptotic Distribution Plot

for  $a_c$ 





#### Conclusions

· The equivalent initial and the critical flaw sizes are insensitive to the specimen thickness.

follow the second asymptotic distribution of the The equivalent initial and the critical flaw sizes maximum value.